# Faking Visual Appearance

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Microsoft Research

SIGGRAPH Panel on Faux Physics
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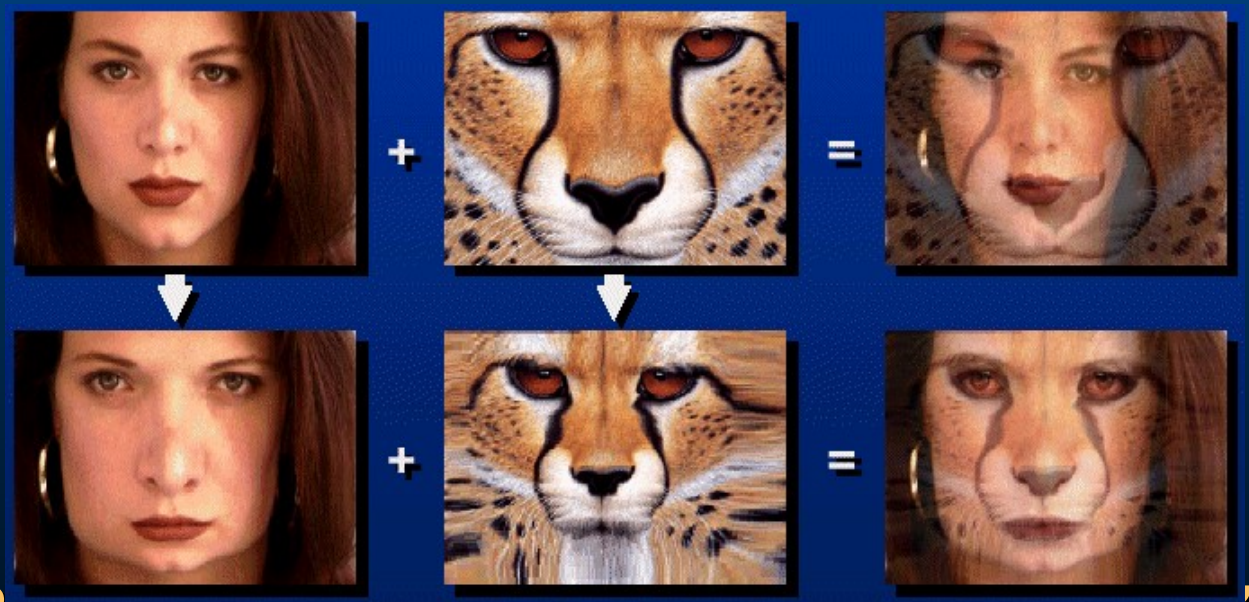
# Image Morphing

- Warp + cross-dissolve = *morph*

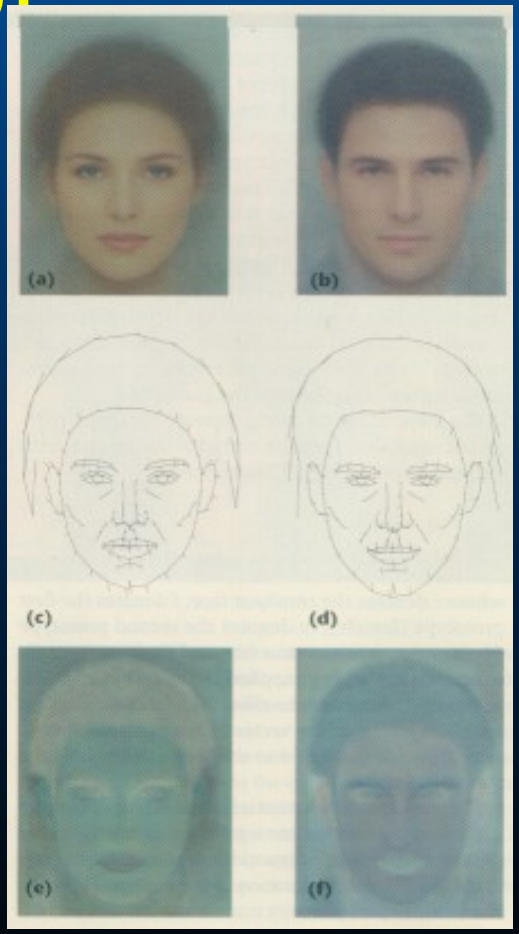


[Beier & Neely 92][Gomes *et al.*'99]

# Manipulating Facial Appearance through Shape and Color

[Rowland and Perrett, IEEE CG&A, Sept.95]

- Compute *average* faces (color and shape)
- Compute *deviations* between male and female



# Changing gender

- Deform shape and/or color of an input face in the direction of "more female"

origina

colorbo

# Enhancing gender

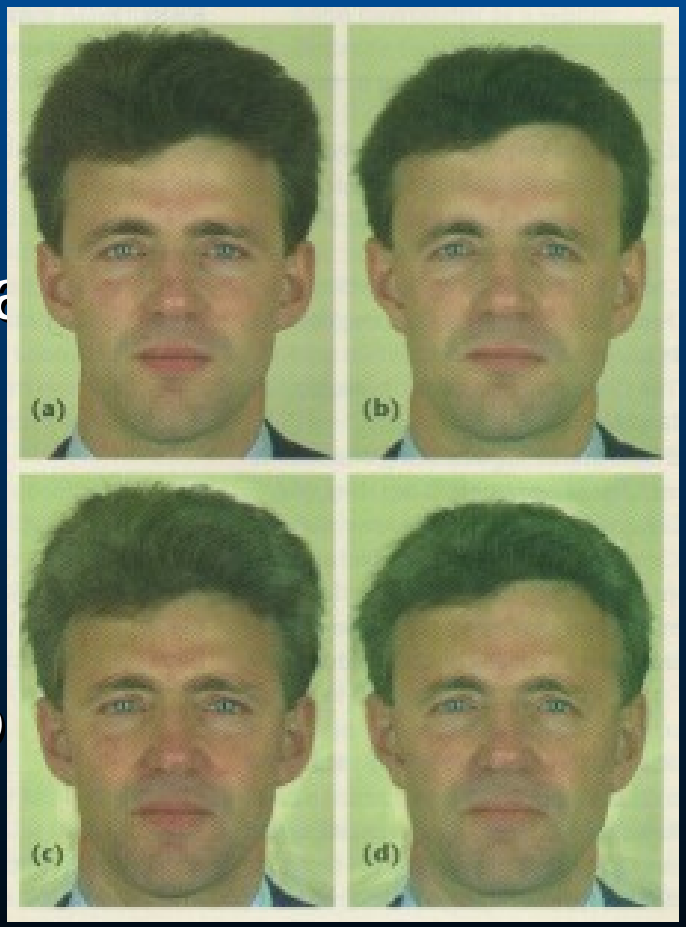
more same *original* androgynous more opposite

# Changing age

- Face becomes “rounder” and “more textured” and “grayer”

origina

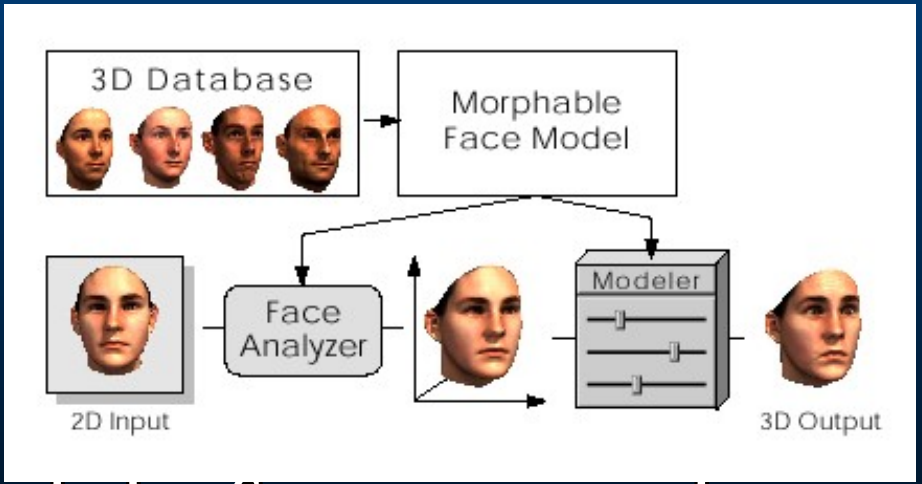
colorb



# Morphable model of 3D faces

[Blanz and Vetter, SIGGRAPH'99]

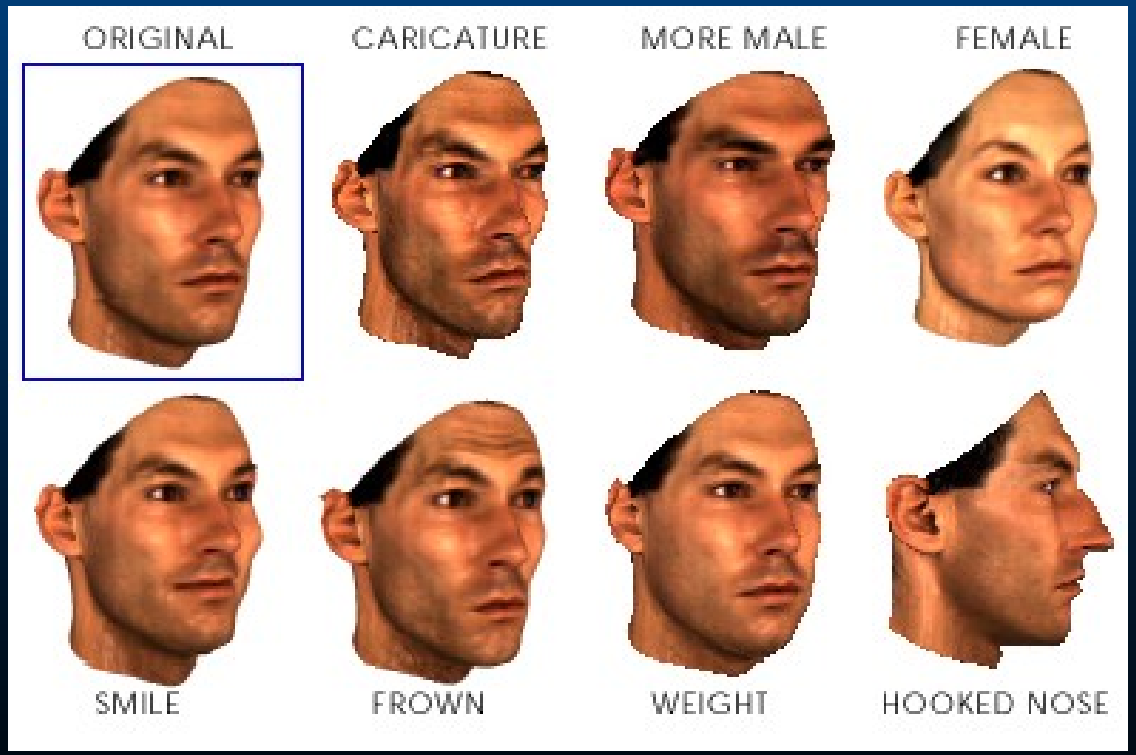
- Start with 200 3D Cyberware scans




- Build a model of *average* shape and texture, and principal *variations*

# Morphable model of 3D faces

- Adding some variations



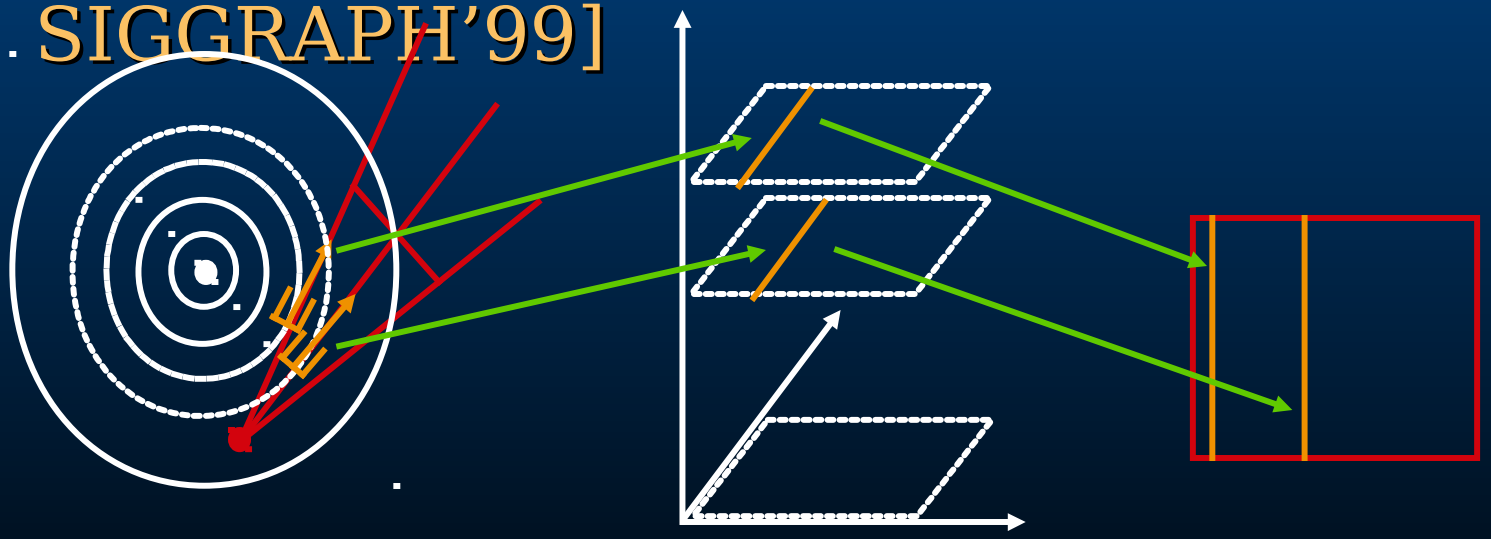
# Image-based Rendering

New area of Computer Graphics, which uses images as rendering primitives

- Panoramic images, Concentric Mosaics
- View interpolation and view morphing
- Lightfield and Lumigraph
- Layered Depth Images
- Sprites with Depth

# Concentric Mosaics

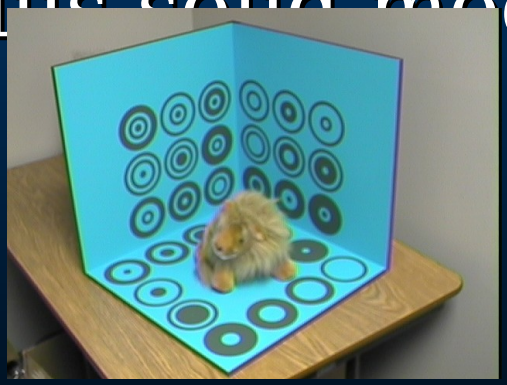
- Interpolate between several panoramas [Shum & He, SIGGRAPH'99]

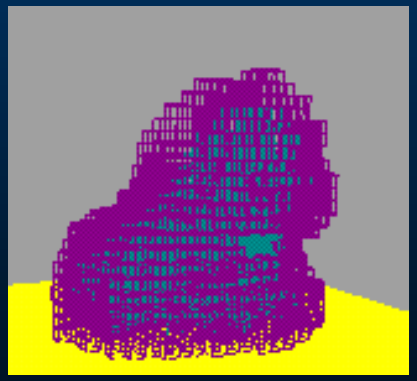


# Concentric Mosaics


# Lumigraph

- Convert video into a solid 3D model based on silhouettes; re-render object from original images plus solid model





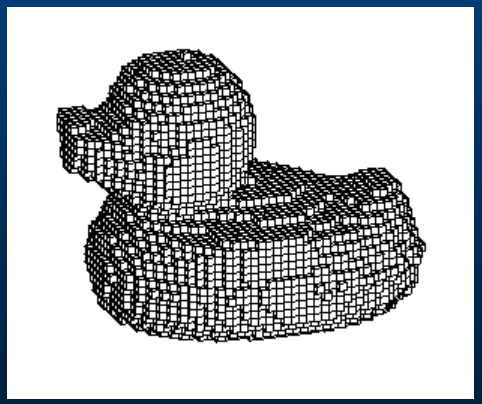
# Image-Based Modeling

Computer Vision is the *inverse* of Computer Graphics:

- computer graphics:
  - given a 3D model, render it
- computer vision
  - given some images, create a 3D model (*geometry, texture, reflectance, lighting, ...*)

# Image-Based Modeling

- 3D model building example



octree 3D curves texture-mapped

# Voxel Coloring

- Carve away a 3D model based on color consistency

# 3D face model building

[Pighin *et al.*, SIGGRAPH'98]

- take photos of a fa
  from different view
- identify key points
  in each image
- recover camera po
  and geometry
- refine geometry

# 3D face model building

- animate by morphing between expres

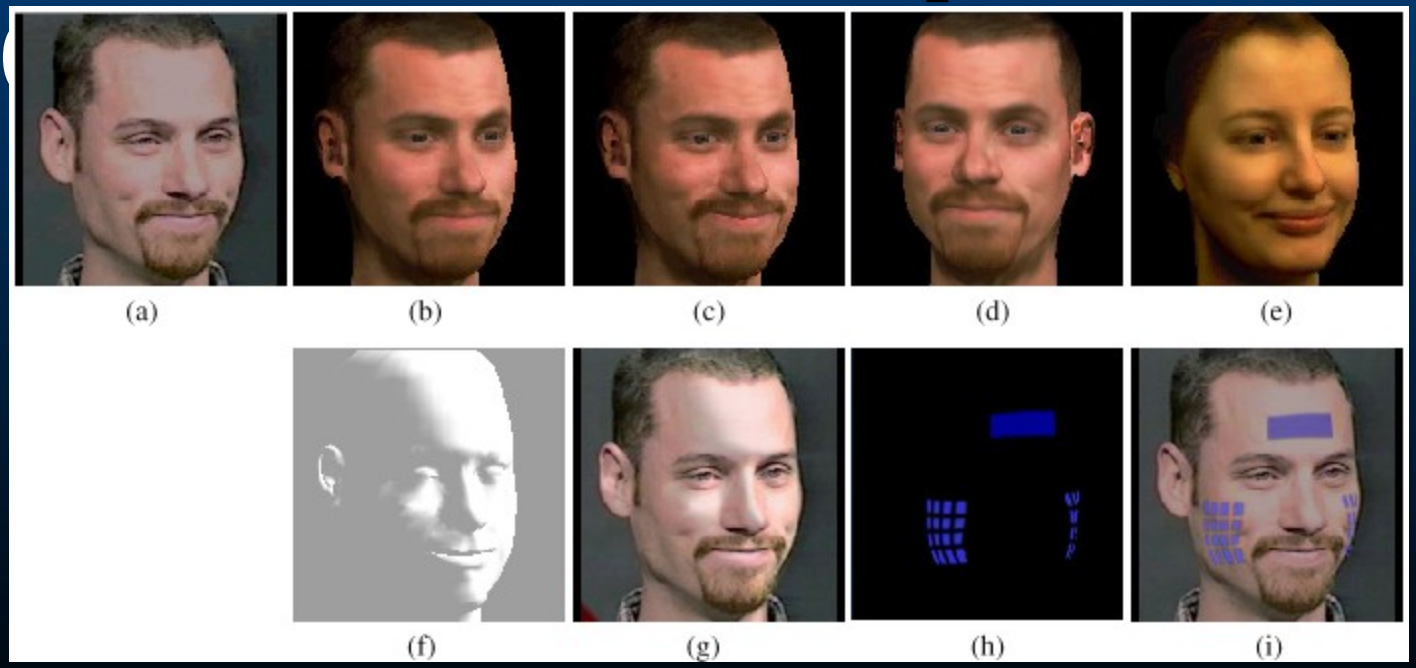
“neutral” “joy”

# 3D face model-based tracking

- Use “analysis by synthesis” to match 3D face model parameters

# 3D model-based effects

- Change viewpoint, identity, illumination, or add special effects



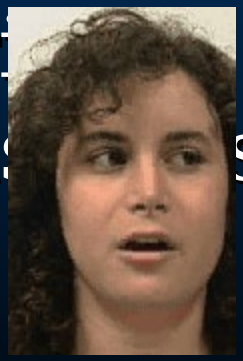
# Video-Based Rendering

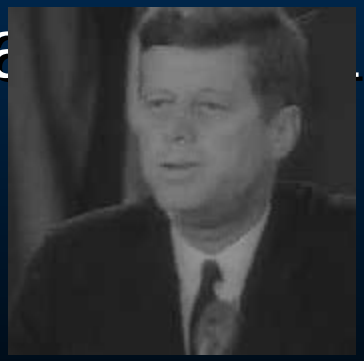
- How can we generate *computer video* instead of *computer images* (stills)?
- A: analyze video and synthesize new *frames*
  - *Video Rewrite*
  - *Video Textures*

# Video Rewrite

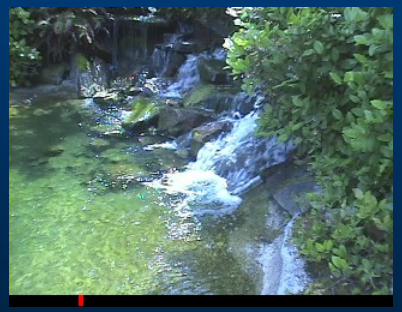
[Bregler *et al.*, SIGGRAPH'97]

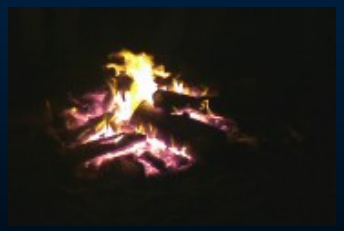
- Train on associated *phonemes* and *visemes*
- Analyze new speech signal in tri[illegible] t[illegible] a[illegible] a[illegible] vi[illegible]s






# Video Clips





# Video Textures

[Schödl *et al.*, SIGGRAPH'2000]

- Take a short *video clip* and turn it into an ∞ amount of continuous *video texture*
  - replace clips in Web pages and presentations
  - screen savers
  - alternative to 3D graphics animation?

# Video Textures

1. find cyclic structure in the video

2. (optional) region-based analysis
3. play frames with random shuffle
4. smooth over discontinuities (morph)

# Interactive fish

# Composited animation

So, what’s your point?

# Data-driven simulation & machine learning

- Data-driven modeling is revolutionizing many aspect of computer science, e.g., trend from rule-based diagnosis to machine learning (Bayes Nets, neural nets…)
- Examples: junk e-mail filtering, medical diagnostics, recommendation systems…

# Data-driven simulation

- 3 kinds of models:
  1. True physical simulation (accurate, predictive)
  2. Simple model + lots of data (data-driven)
     - [Bregler 97; Blanz & Vetter 99]
     - HMMs for speech recognition ≠ true language model
  3. Tons of data: sample-based rendering
     - sample-based music synthesis
     - concatenated speech synthesis
     - previous (pure) IBR & VBR examples

# Modeling: pros. & cons.

- Advantages:
  - truer reality
  - easier to control and extrapolate
  - compactness (geometry + photometry)
- Disadvantages:
  - harder to achieve visual fidelity
  - longer development cycle
    (but isn't that what science is about? ☺)

# Faking Visual Appearance

- We can often *fake* visual appearance from samples (input images and video)
- To achieve acceptable realism, we sometimes *have* to use real source data
- Choosing the right level of model (data rich/poor, representation) is usually the *key*